

SCIENCE

FRIDAY, SEPTEMBER 20, 1912

CONTENTS

<i>The British Association for the Advancement of Science:—</i>	
<i>Zoological Gardens and the Preservation of Fauna: DR. P. CHALMERS MITCHELL</i>	353
<i>The Eighth International Congress of Applied Chemistry: PROFESSOR JOS. W. RICHARDS</i>	365
<i>Henry Adam Weber</i>	368
<i>The Dedication of the Rice Institute</i>	368
<i>Scientific Notes and News</i>	369
<i>University and Educational News</i>	373
<i>Discussion and Correspondence:—</i>	
<i>A New Mathematical Prize: PROFESSOR G. A. MILLER</i>	374
<i>Scientific Books:—</i>	
<i>Plimmer on the Chemical Constitution of Proteins: PROFESSOR THOMAS B. OSBORNE.</i>	
<i>Verworn's Physiologisches Praktikum für Mediziner: PROFESSOR FREDERIC S. LEE.</i>	
<i>Morecraft and Hehre's Short Course in Electrical Testing: PROFESSOR HAROLD PENDER</i>	374
<i>Scientific Journals and Articles</i>	377
<i>Notes on Entomology: PROFESSOR NATHAN BANKS</i>	377
<i>Special Articles:—</i>	
<i>Sheep-breeding Experiments on Beinn Bhreagh: DR. ALEXANDER GRAHAM BELL</i>	378

MSB. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

ZOOLOGICAL GARDENS AND THE PRESERVATION OF FAUNA¹

IN thinking over possible subjects for this presidential address, I was strongly tempted to enter on a discussion of the logical methods and concepts that we employ in zoology. The temptation was specially strong to a Scot speaking in Scotland, that he should devote the hour when the prestige of the presidential chair secured him attention, to putting his audience right on logic and metaphysics. But I reflected that zoology is doing very well, however its logic be wavering, and that as all lines subtend an equal angle at infinity, it would be of small moment if I were to postpone my remarks on metaphysics. And so I am to essay a more modest but a more urgent theme, and ask you to consider the danger that threatens the surviving land-fauna of this globe. A well-known example may serve to remind you how swift is the course of destruction. In 1867, when the British Association last met at Dundee, there were still millions of bison roaming over the prairies and forests of North America. In that year the building of the Union Pacific, the first great transcontinental railway, cut the herd in two. The southern division, consisting itself of several million individuals, was wiped out between 1871 and 1874, and the practical destruction of the northern herd was completed between 1880 and 1884. At present there are only two herds of wild bison in existence. In the Yellowstone Park only about twenty individuals remained in 1911, the greater part of the

¹Address of the president of the Zoological Section of the British Association for the Advancement of Science. Dundee, 1912.

herd having been killed by poachers. A larger number, over three hundred, still survive near the Great Slave Lake, and there are probably nearly two thousand in captivity, in various zoological gardens, private domains and state parks. It is only by the deliberate and conscious interference of man that the evil wrought by man has been arrested.

A second example that I may select is also taken from the continent of North America, but it is specially notable because it is sometimes urged, as in India, that migratory birds require no protection. Audubon relates that just a century ago passenger pigeons existed in countless millions, and that for four days at a time the sky was black with the stream of migration. The final extinction of this species has taken place since the last meeting of the association in Dundee. In 1906 there were actually five single birds living, all of which had been bred in captivity, and I understand that these last survivors of a prolific species are now dead, although the birds ranged in countless numbers over a great continent.

It would be futile to discuss in detail the precise agencies by which the destruction of animal life is wrought, or the pretexts or excuses for them. The most potent factors are the perfection of the modern firearm and the enormous increase in its use by civilized and barbarous man. Sometimes the pretext is sport, sometimes wanton destructiveness rules. The extermination of beasts-of-prey, the clearing of soil for stock or crops, the securing of meat, the commercial pursuit of hides and horns and of furs and feathers, all play their part. Farmers and settlers on the outskirts of civilization accuse the natives, and allege that the problem would be solved were no firearms allowed to any but themselves. Sportsmen accuse other sportsmen,

whom they declare to be no real sportsmen, and every person whose object is not sport. The great museums, in the name of science, and the rich amateur collectors press forward to secure the last specimens of moribund species.

But even apart from such deliberate and conscious agencies, the near presence of man is inhospitable to wild life. As he spreads over the earth, animals wither before him, driven from their haunts, deprived of their food, perishing from new diseases. It is part of a general biological process. From time to time, in the past history of the world, a species favored by some happy kink of structure or fortunate accident of adaptability, has become dominant. It has increased greatly in numbers, outrunning its natal bounds, and has radiated in every possible direction, conquering woodland and prairies, the hills and the plains, transcending barriers that had seemed impassable, and perhaps itself breaking up into new local races and varieties. It must be long since such a triumphant progress was unattended by death and destruction. When the first terrestrial animals crept out of their marshes into the clean air of the dry land, they had only plants and the avenging pressure of physical forces to overcome. But when the amphibians were beaten by the reptiles, and when from amongst the reptiles some insignificant species acquired the prodigious possibility of transformation to mammals, and still more when amongst the mammals eutherian succeeded marsupial, carnivore the creodont and man the ape, it could have been only after a fatal contest that the newcomers triumphed. The struggle, we must suppose, was at first most acute between animals and their nearest inferior allies, as similarity of needs brings about the keenest competition, but it must afterwards

have been extended against lower and lower occupants of the coveted territory.

The human race has for long been the dominant terrestrial species, and man has a wider capacity for adaptation to different environments, and an infinitely greater power of transcending geographical barriers than have been enjoyed by any other set of animals. For a considerable time many of the more primitive tribes, especially before the advent of firearms, had settled down into a kind of natural equilibrium with the local mammalian fauna, but these tribes have been first driven to a keener competition with the lower animals, and then, in most parts of the world, have themselves been forced almost or completely out of existence. The resourceful and aggressive higher races have now reached into the remotest parts of the earth and have become the exterminators. It must now be the work of the most intelligent and provident amongst us to arrest this course of destruction and to preserve what remains.

In Europe, unfortunately, there is little left sufficiently large and important to excite the imagination. There is the European bison which has been extinct in western Europe for many centuries, whilst the last was killed in east Prussia in 1755. There remains a herd of about seven hundred in the forests of Lithuania, strictly protected by the Tsar, whilst there are truly wild animals, in considerable numbers, in the Caucasus, small captive herds on the private estates of the Tsar, the Duke of Pless and Count Potocki, and a few individuals in various zoological gardens. There is the beaver, formerly widespread in Europe, now one of the rarest of living mammals, and lingering in minute numbers in the Rhone, the Danube, in a few Russian rivers and in protected areas in Scandinavia. The wolf and the bear have shrunk to the recesses of thick forests and

the remotest mountains, gluttons to the most barren regions of the north. The chamois survives by favor of game laws and the vast inaccessible areas to which it can retreat, but the mouflon of Corsica and Sardinia and the ibex in Spain are on the verge of extinction. Every little creature, from the otter, wild cat and marten to the curious desman is disappearing.

India contains the richest, the most varied, and, from many points of view, the most interesting part of the Asiatic fauna. Notwithstanding the teeming human population it has supported from time immemorial, the extent of its area, its dense forests and jungles, its magnificent series of river valleys, mountains and hills have preserved until recent times a fauna rich in individuals and species. The most casual glance at the volumes by sportsmen and naturalists written forty or fifty years ago reveals the delight and wonder of travel in India so comparatively recently as the time when the association last met in Dundee. Sir H. H. Johnston has borne witness that even in 1895 a journey "through almost any part of India was of absorbing interest to the naturalist." All is changed now, and there seems little doubt but that the devastation in the wonderful mammalian fauna has been wrought chiefly by British military officers and civilians, partly directly, and partly by their encouragement of the sporting instincts of the Mohammedan population and the native regiments, although the clearing of forests and the draining of marshlands have played an important contributory part. The tiger has no chance against the modern rifle. The one-horned rhinoceros has been nearly exterminated in northern India and Assam. The magnificent gaur, one of the most splendid of living creatures, has been almost killed off throughout the limits of its range—southern India and the Malay

Peninsula. Bears and wolves, wild dogs and leopards are persecuted remorselessly. Deer and antelope have been reduced to numbers that alarm even the most thoughtless sportsmen, and wild sheep and goats are being driven to the utmost limits of their range.

When I speak of the fauna of Africa, I am always being reminded of the huge and pathless areas of the Dark Continent, and assured that lions and leopards, elephants and giraffe still exist in countless numbers, nor do I forget the dim recesses of the tropical forests where creatures still lurk of which we have only the vaguest rumor. But we know that south Africa, less than fifty years ago, was a dream that surpassed the imagination of the most ardent hunter. And we know what it is now. It is traversed by railways, it has been rolled over by the devastations of war. The game that once covered the land in unnumbered millions is now either extinct, like the quagga and the black wildebeeste, or its scanty remnant lingers in a few reserves and on a few farms. The sportsman and the hunter have been driven to other parts of the continent, and I have no confidence in the future of the African fauna. The mountains of the moon are within range of a long vacation holiday. Civilization is eating into the land from every side. All the great European countries are developing their African possessions. There are exploring expeditions, punitive expeditions, shooting and collecting expeditions. Railways are being pushed inland, water-routes opened up. The land is being patrolled and policed and taxed, and the wild animals are suffering. Let us go back for a moment to the Transvaal and consider what has happened since the Rand was opened, neglecting the reserves. Lions are nearly extinct. The hyena has been trapped and shot and poisoned out of exist-

ence. The eland is extinct. The giraffe is extinct. The elephant is extinct. The rhinoceros is extinct. The buffalo is extinct. The bontebok, the red hartebeeste, the mountain zebra, the oribi and the grysbok are so rare as to be practically extinct. And the same fate may at any time overtake the rest of Africa. The white man has learned to live in the tropics; he is mastering tropical diseases; he has need of the vegetable and mineral wealth that lie awaiting him, and although there is yet time to save the African fauna, it is in imminent peril.

When we turn to Australia with its fauna of unique zoological interest, we come to a more advanced case of the same disease. In 1909 Mr. G. C. Shortridge, a very skilled collector, working for the British Museum, published in the *Proceedings of the Zoological Society of London* the results of an investigation he had carried out on the fauna of western Australia south of the tropics, during the years 1904-1907. He gave a map showing the present and comparatively recent distribution for each of the species of marsupials and monotremes indigenous to that locality. West Australia as yet has been very much less affected by civilization than Queensland, New South Wales or Victoria, and yet in practically every case there was found evidence of an enormous recent restriction of the range of the species. Marsupials and monotremes are, as you know, rather stupid animals, with small powers of adaptation to new conditions, and they are in the very gravest danger of complete extinction. In the island of Tasmania, the thylacine or marsupial wolf, and the Tasmanian devil have unfortunately incurred the just hostility of the stock raiser and poultry farmer, and the date of their final extermination is approaching at a pace that must

be reckoned by months rather than by years.

The development of the continent of North America has been one of the wonders of the history of the world, and we on this side of the Atlantic almost hold our breath as we try to realize the material wealth and splendor and the ardent intellectual and social progress that have turned the United States into an imperial nation. But we know what has happened to the American bison. We know the danger that threatens the pronghorn, one of the most isolated and interesting of living creatures, the Virginian deer, the mule-deer and the bighorn sheep. Even in the wide recesses of Canada, the bighorn, the caribou, the elk, the wapiti, the white mountain goat and the bears are being rapidly driven back by advancing civilization. In South America less immediate danger seems to threaten the jaguar and maned wolf, the tapirs and ant-eaters and sloths, but the energy of the rejuvenated Latin races points to a huge encroachment of civilization on wild nature at no distant date.

You will understand that I am giving examples and not a catalogue even of threatened terrestrial mammals. I have said nothing of the aquatic carnivores, nothing of birds or of reptiles or of batrachians and fishes. And to us who are zoologists, the vast destruction of invertebrate life, the sweeping out, as forests are cleared and the soil tilled, of innumerable species that are not even named or described, is a real calamity. I do not wish to appeal to sentiment. Man is worth many sparrows; he is worth all the animal population of the globe, and if there were not room for both, the animals must go. I will pass no judgment on those who find the keenest pleasure of life in gratifying the primeval instinct of sport. I will admit

that there is no better destiny for the lovely plumes of a rare bird than to enhance the beauty of a beautiful woman. I will accept the plea of those who prefer a well-established trinomial to a moribund species. But I do not admit the right of the present generation to careless indifference or to wanton destruction. Each generation is the guardian of the existing resources of the world; it has come into a great inheritance, but only as a trustee. We are learning to preserve the relics of early civilizations, and the rude remains of man's primitive arts and crafts. Every civilized nation spends great sums on painting and sculpture, on libraries and museums. Living animals are of older lineage, more perfect craftsmanship and greater beauty than any of the creations of man. And although we value the work of our forefathers, we do not doubt but that the generations yet unborn will produce their own artists and writers, who may equal or surpass the artists and writers of the past. But there is no resurrection or recovery of an extinct species, and it is not merely that here and there one species out of many is threatened, but that whole genera, families and orders are in danger.

Now let me turn to what is being done and what has been done for the preservation of fauna. I must begin by saying, and this was one of the principal reasons for selecting the subject of my address, that we who are professional zoologists, systematists, anatomists, embryologists and students of general biological problems, in this country at least, have not taken a sufficiently active part in the preservation of the realm of nature that provides the reason for our existence. The first and most practical step of world-wide importance was taken by a former president of the British Association, the late Lord Salisbury, one of the few in the long roll of

English statesmen whose mind was attuned to science. In 1899 he arranged for a convention of the great powers interested in Africa to consider the preservation of what were curiously described as the "Wild Animals, Birds and Fish" of that continent. The convention, which did most important pioneer work, included amongst its members another president of this association, Sir Ray Lankester, whom we hold in high honor in this section as the living zoologist who has taken the widest interest in every branch of zoology. But it was confined in its scope to creatures of economic or of sporting value. And from that time on the central authorities of the great powers and the local administrators, particularly in the case of tropical possessions, seem to have been influenced in the framing of their rules and regulations chiefly by the idea of preserving valuable game animals. Defining the number of each kind of game that can be killed, charging comparatively high sums for shooting permits, and the establishment of temporary or permanent reserved tracts in which the game may recuperate, have been the principal methods selected. On these lines, narrow although they are, much valuable work has been done, and the parts of the world where unrestricted shooting is still possible are rapidly being limited. I may take the proposed new Game Act of our Indian Empire, which has recently been explained, and to a certain extent criticized, in the *Proceedings of the Zoological Society of London*, by Mr. E. P. Stebbing, an enlightened sportsman-naturalist, as an example of the efforts that are being made in this direction, and of their limitations.

The act is to apply to all India, but much initiative is left to local governments as to the definition of the important words "game" and "large animal." The act, however, declares what the words are to

mean in the absence of such local definitions, and it is a fair assumption that local interpretations will not depart widely from the lead given by the central authority. Game is to include the following in their wild state: Pigeons, sandgrouse, peafowl, jungle-fowl, pheasants, partridges, quail, spurfowl, florican and their congeners; geese, ducks and their congeners; woodcock and snipe. So much for birds. Mammals include hares and "large animals" defined as "all kinds of rhinoceros, buffalo, bison, oxen; all kinds of sheep, goats, antelopes and their congeners; all kinds of gazelle and deer."

The act does not affect the pursuit, capture or killing of game by non-commissioned officers or soldiers on whose behalf regulations have been made, or of any animal for which a reward may be claimed from government, of any large animal in self-defence, or of any large animal by a cultivator or his servants, whose crops it is injuring. Nor does it affect anything done under license for possessing arms and ammunition to protect crops, or for destroying dangerous animals, under the Indian Arms Act. Then follow prohibitory provisions all of which refer to the killing or to the sale or possession of game or fish, and provisions as to licenses for sportsmen, the sums to be paid for which are merely nominal, but which carry restrictions as to the number of head that may be killed. I need not enter upon detailed criticism as to the vagueness of this act from the zoological point of view, or as to the very large loopholes which its provisions leave to civil and military sportsmen; these have been excellently set forth by Mr. Stebbing, who has full knowledge of the special conditions which exist in India. What I desire to point out is that it conceives of animals as game rather than as animals, and that it does not even contemplate the possi-

bility of the protection of birds-of-prey and beasts-of-prey, and still less of the enormous numbers of species of animals that have no sporting or economic value.

Mr. Stebbing's article also gives a list of the very large number of reserved areas in India, which are described as "Game Sanctuaries." His explanation of them is as follows:

With a view to affording a certain protection to animals of this kind (the elephant, rhinoceros, ruminants, etc.) and of giving a rest to species which have been heavily thinned in a district by indiscriminate shooting in the past, or by anthrax, drought, etc., the idea of the Game Sanctuary was introduced into India (and into other parts of the world) and has been accepted in many parts of the country. The sanctuary consists of a block of country, either of forest or of grassland, etc., depending on the nature of the animal to which sanctuary is required to be given; the area has rough boundaries such as roads, fire lines, nullahs, etc., assigned to it, and no shooting of any kind is allowed in it, if it is a sanctuary pure and simple; or the shooting of carnivora may be permitted, or of these latter and of everything else save certain specified animals.

Mr. Stebbing goes on to say that sanctuaries may be formed in two ways. The area may be automatically closed and reopened for certain definite periods of years, or be closed until the head of game has become satisfactory, the shooting on the area being then regulated, and no further closing taking place, save for exceptional circumstances. The number of such sanctuary blocks, both in British India and in the native states, will cause surprise and pleasure to most readers, and it can not be doubted but that they will have a large effect on the preservation of wild life. The point, however, that I wish to make is that in the minds of those who have framed the game act, and of those who have caused the making of the sanctuaries—as indeed in the minds of their most competent critics—the dominant idea has been the hus-

banding of game animals, the securing for the future of sport for sportsmen. I do not forget that there is individual protection for certain animals; no elephant, except a rogue elephant, may be shot in India, and there are excellent regulations regarding birds with plumage of economic value. The fact remains that India, a country which still contains a considerable remnant of one of the richest faunas of the world, and which also is probably more efficiently under the autocratic control of a highly educated body of permanent officials, central and local, than any other country in the world, has no provision for the protection of its fauna simply as animals.

The conditions in Africa are very different from those in India. The land is portioned out amongst many powers. The settled population is much less dense and the hold of the white settler and the white ruler is much less complete. The possibility of effective control of native hunters and of European travelers and sportsmen is much smaller, and as there are fewer sources of revenue, the temptation to exploit the game for the immediate development of the struggling colonies is much greater. Still, the lesson of the extinction of the South African fauna is being taken to heart. I have had the opportunity of going through the regulations made for the shooting of wild animals in Africa by this country, by our autonomic colonies, by France, Germany, Italy, Portugal and Belgium, and, with the limitation that they are directed almost solely towards the protection of animals that can be regarded as game, they afford great promise for the future. But this limitation is still stamped upon them, and even so enthusiastic a naturalist as Major Stevenson-Hamilton, the warden of the Transvaal Government Game Reserves, who has advocated the substitu-

tion of the camera for the rifle, appears to be of the opinion that the platform of the convention of 1900 is sufficient. It included the sparing of females and immature animals, the establishment of close seasons and game sanctuaries, the absolute protection of rare species, restrictions on the export for trading purposes of skins, horns and tusks, and the prohibition of pits, snares and game traps. Certainly the rulers of Africa are seeing to the establishment of game reserves. As for British Africa, there are two in Somaliland, two in the Sudan, two in Uganda and two in British East Africa (with separate reserves for eland, rhinoceros and hippopotamus), two in Nyasaland, three in the Transvaal, seven in Rhodesia, several in Natal and in Cape Colony, and at least four in Nigeria. These are now administered by competent officials, who in addition are usually the executive officers of the game laws outside the reserved territory. Here again, however, the preservation of game animals and of other animals of economic value, and of a few named species is the fundamental idea. In 1909 I had the honor of being a member of a deputation to the Secretary of State for the Colonies, arranged by the Society for the Preservation of the Wild Fauna of the Empire, one of the most active and successful bodies engaged in arousing public opinion on the subject. Among the questions on which we were approaching Lord Crewe was that of changes in the locality of reserves. Sometimes it had happened that for the convenience of settlers or because of railway extension, or for some other reason, proposals were made to open or clear the whole or part of a reserve. When I suggested that the substitution of one piece of ground for another, even of equivalent area, might be satisfactory from the point of view of the preservation

of large animals, but was not satisfactory from the zoological point of view, that in fact pieces of primeval land and primeval forest contained many small animals of different kinds which would be exterminated once and for all when the land was brought under cultivation, the point was obviously new not only to the Colonial Secretary, who very courteously noted it, but to my colleagues.

This brings me to the general conclusion to which I wish to direct your attention and for which I hope to engage your sympathy. We may safely leave the preservation of game animals, or rare species if these are well known and interesting, and of animals of economic value, to the awakened responsibility and the practical sense of the governing powers, stimulated as these are by the enthusiasm of special societies. Game laws, reserves where game may recuperate, close seasons, occasional prohibition and the real supervision of license holders are all doing their work effectively. But there remains something else to do, something which I think should interest zoologists particularly, and on which we should lead opinion. There exist in all the great continents large tracts almost empty of resident population, which still contain vegetation almost undisturbed by the ravages of man, and which still harbor a multitude of small animals, and could afford space for the larger and better-known animals. These tracts have not yet been brought under cultivation, and are rarely traversed except by the sportsman, the explorer and the prospector. On these there should be established, in all the characteristic faunistic areas, reservations which should not be merely temporary recuperating grounds for harassed game, but absolute sanctuaries. Under no condition should they be open to the sportsman. No gun should be fired, no animal

slaughtered or captured save by the direct authority of the wardens of the sanctuaries, and for the direct advantage of the denizens of the sanctuaries, for the removal of noxious individuals, the controlling of species that were increasing beyond reason, the extirpation of diseased or unhealthy animals. The obvious examples are not the game reserves of the old world, but the national parks of the new world and of Australasia. In the United States, for instance, there are now the Yellowstone National Park with over two million acres, the Yosemite in California with nearly a million acres, the Grand Cañon Game Preserve with two million acres, the Mount Olympus National Monument in Washington with over half a million acres and the Superior Game and Forest Preserve with nearly a million acres, as well as a number of smaller reserves for special purposes, and a chain of coastal areas all round the shores for the preservation of birds. In Canada, in Alberta, there are the Rocky Mountains Park, the Yoho Park, Glacier Park and Jasper Park, together extending to over nine million acres, whilst in British Columbia there are smaller sanctuaries. These, so far as laws can make them, are inalienable and inviolable sanctuaries for wild animals. We ought to have similar sanctuaries in every country of the world, national parks secured for all time against all the changes and chances of the nations by international agreement. In the older and more settled countries the areas selected unfortunately must be determined by various considerations, of which faunistic value can not be the most important. But certainly in Africa, and in large parts of Asia, it would still be possible that they should be selected in the first place for their faunistic value. The scheme for them should be drawn up by an international commission of experts in the geo-

graphical distribution of animals, and the winter and summer haunts of migratory birds should be taken into consideration. It is for zoologists to lead the way, by laying down what is required to preserve for all time the most representative and most complete series of surviving species without any reference to the extrinsic value of the animals. And it then will be the duty of the nations, jointly and severally, to arrange that the requirements laid down by the experts shall be complied with.

And now I come to the last side of my subject, that of zoological gardens, with which I have been specially connected in the last ten years. My friend M. Gustave Loisel, in his recently issued monumental "*Histoire des Ménageries*" has shown that in the oldest civilizations of which we have record, thousands of years before the Christian era, wild animals were kept in captivity. He is inclined to trace the origin of the custom to a kind of totemism. Amongst the ancient Egyptians, for instance, besides the bull and the serpent, baboons, hippopotami, cats, lions, wolves, ichneumons, shrews, wild goats and wild sheep, and of lower animals, crocodiles, various fishes and beetles were held sacred in different towns. These animals were protected, and even the involuntary killing of any of them was punished by the death of the slayer, but besides this general protection, the priests selected individuals which they recognized by infallible signs as being the divine animals, and tamed, guarded and fed in the sacred buildings, whilst the revenues derived from certain tracts of land were set apart for their support. The Egyptians were also famous hunters and kept and tamed various wild animals, including cheetahs, striped hyenas, leopards, and even lions which they used in stalking their prey. The tame lions were sometimes clipped, as in ancient

Assyria, and used both in the chase and in war. The rich Egyptians of Memphis had large parks in which they kept not only the domestic animals we now know, but troops of gazelles, antelopes and cranes which were certainly tame and were herded by keepers with wands. So also in China at least fifteen centuries before our era, wild animals were captured in the far north by the orders of the emperor and were kept in the royal parks. A few centuries later the Emperor Wen-Wang established a zoological collection between Peking and Nankin, his design being partly educational, as it was called the Park of Intelligence. In the valley of the Euphrates, centuries before the time of Moses, there were lists of sacred animals, and records of the keeping in captivity of apes, elephants, rhinoceroses, camels and dromedaries, gazelles and antelopes, and it may well be that the legend of the Garden of Eden is a memory of the royal menagerie of some ancient king. The Greeks, whose richest men had none of the wealth of the Egyptians or of the princes of the East, do not appear to have kept many wild animals, but the magnates of imperial Rome captured large numbers of leopards, lions, bears, elephants, antelopes, giraffes, camels, rhinoceroses and hippopotami, and ostriches and crocodiles, and kept them in captivity, partly for use in the arena, and partly as a display of the pomp and power of wealth. In later times royal persons and territorial nobles frequently kept menageries of wild animals, aviaries and aquaria, but all of these have long since vanished.

Thus, although the taste for keeping wild animals in captivity dates from the remotest antiquity, all the modern collections are of comparatively recent origin, the oldest being the Imperial Menagerie of the palace of Schönbrunn, Vienna, which

was founded about 1752, whilst some of the most important are only a few years old. These existing collections are of two kinds. A few are the private property of wealthy landowners, and their public importance is due partly to the opportunity they have afforded for experiments in acclimatization on an extensive scale, and still more to the refuge they have given to the relics of decaying species. The European bison is one of the best-known cases of such preservation, but a still more extraordinary instance is that of Père David's deer, a curious and isolated type which was known only in captivity in the imperial parks of China. The last examples in China were killed in the Boxer war, and the species would be absolutely extinct but for the small herd maintained by the Duke of Bedford at Woburn Abbey. In 1909 this herd consisted of only twenty-eight individuals; it now numbers sixty-seven. The second and best-known types of collections of living animals are in the public zoological gardens and parks maintained by societies, private companies, states and municipalities. There are now more than a hundred of these in existence, of which twenty-eight are in the United States, twenty in the German Empire, five in England, one in Ireland, and none in Scotland. But perhaps I may be allowed to say how much I hope that the efforts of the Zoological Society of Scotland will be successful, and that before many months are over there will be a zoological park in the capital of Scotland. There is no reason of situation or of climate which can be urged against it. The smoke and fog of London are much more baleful to animals than the east winds of Edinburgh. The gardens of north Germany and the excellent institution at Copenhagen have to endure winters much more severe than those of lowland Scotland, whilst the arctic

winter and tropical summer of New York form a peculiarly unfortunate combination, and none the less the Bronx Park at New York is one of the most delightful menageries in existence. The Zoological Society of Scotland will have the great advantage of beginning where other institutions have left off; it will be able to profit by the experience and avoid the mistakes of others. The Zoological Society of London would welcome the establishment of a menagerie in Scotland, for scientific and practical reasons. As I am speaking in Scotland, I may mention two of the practical reasons. The first is that in Great Britain we labor under a serious disadvantage as compared with Germany with regard to the importation of rare animals. When a dealer in the tropics has rare animals to dispose of, he must send them to the best market, for dealing in wild animals is a risky branch of commerce. If he send them to this country, there are very few possible buyers, and it often happens that he is unable to find a purchaser. If he send them to Germany, one or other of the twenty gardens is almost certain to absorb them, and failing Germany, Belgium and Holland are near at hand. Were there twenty prosperous zoological gardens in Great Britain, they could be better stocked, at cheaper rates, than those we have now. The second practical reason is that it is a great advantage to menageries to have easy opportunities of lending and exchanging animals; for it often happens that as a result of successful breeding or of gifts on the one hand, or of deaths on the other, a particular institution is overstocked with one species or deficient in another.

One of the ideas strongly in the minds of those who founded the earlier of modern zoological gardens was the introduction and acclimatization of exotic animals

that might have an economic value. It is curious how completely this idea has been abandoned and how infertile it has proved. The living world would seem to offer an almost unlimited range of creatures which might be turned to the profit of man and as domesticated animals supply some of his wants. And yet I do not know of any important addition to domesticated animals since the remotest antiquity. A few birds for the coverts, fancy water-fowl for ponds and lakes, and brightly plumaged birds for cages or for aviaries have been introduced, chiefly through zoological societies, but we must seek other reasons for their existence than these exiguous gains.

Menageries are useful in the first place as educational institutions, in the widest sense of the word. Every new generation should have an opportunity of seeing the wonder and variety of animated nature, and of learning something that they can not acquire from books or pictures or lectures about the chief types of wild animals. For that reason zoological gardens should be associated in some form with elementary and secondary education. We in London admit the children from elementary schools on five mornings in the week at the nominal charge of a penny for each child, and in cooperation with the educational committee of the London County Council, we conduct courses of lectures and demonstrations for the teachers who will afterwards bring their children to visit the gardens.

Menageries provide one of the best schools for students of art, for nowhere else than amongst living animals are to be found such strange fantasies of color, such play of light on contour and surface, such intricate and beautiful harmonies of function and structure. To encourage art the London Society allows students of recognized schools of drawing and painting,

modelling and designing, to use the gardens at nominal rates.

Menageries provide a rich material for the anatomist, histologist, physiologist, parasitologist and pathologist. It is surprising to note how many of the animals used by Lamarck and Cuvier, Johannes Müller and Wiedersheim, Owen and Huxley were obtained from zoological gardens. At all the more important gardens increasing use is being made of the material for the older purposes of anatomical research and for the newer purposes of pathology and physiology.

There remains the fundamental reason for the existence of menageries, that they are collections of living animals and therefore an essential material for the study of zoology. Systematic zoology, comparative anatomy, and even morphology, the latter the most fascinating of all the attempts of the human intellect to recreate nature within the categories of the human mind, have their reason and their justification in the existence of living animals under conditions in which we can observe them. And this leads me to a remark which ought to be a truism but which, unfortunately, is still far from being a truism. The essential difference between a zoological museum and a menagerie is that in the latter the animals are alive. The former takes its value from its completeness, from the number of rare species of which it has examples, and from the extent to which its collections are properly classified and arranged. The value of a menagerie is not its zoological completeness, not the number of rare animals that at any moment it may contain, not even the extent to which it is duly labeled and systematically arranged, but the success with which it displays its inhabitants as living creatures under conditions in which they can exercise at least some of their vital activities.

The old ideal of a long series of dens or cages in which representatives of kindred species could mope opposite their labels is surely but slowly disappearing. It is a museum arrangement, and not an arrangement for living animals. The old ideal by which the energy and the funds of a menagerie were devoted in the first place to obtaining species "new to the collection" or "new to science" is surely but slowly disappearing. It is the instinct of a collector, the craving of a systematist, but is misplaced in those who have the charge of living animals. Certainly we like to have many species, to have rare species, and even to have new species represented in our menageries. But what we are learning to like most of all is to have the examples of the species we possess, whether these be new or old, housed in such a way that they can live long, and live happily, and live under conditions in which their natural habits, instincts, movements and routine of life can be studied by the naturalist and enjoyed by the lover of animals.

Slowly the new conditions are creeping in, most slowly in the older institutions hampered by lack of space, cumbered with old and costly buildings, oppressed by the habits of long years and the traditions established by men who none the less are justly famous in the history of zoological science. Space, open air, scrupulous attention to hygiene and diet, the provision of some attempt at natural environment are receiving attention that they have never received before. You will see the signs of the change in Washington and New York, in London and Berlin, in Antwerp and Rotterdam, and in all the gardens of Germany. It was begun simultaneously, or at least independently, in many places and under the inspiration of many men. It is, I think, part of a general process in which civilized man is re-

placing the old hard curiosity about nature by an attempt at sympathetic comprehension. We no longer think of ourselves as alien from the rest of nature, using our lordship over it for our own advantage; we recognize ourselves as part of nature, and by acknowledging our kinship we are on the surest road to an intelligent mastery. But I must mention one name, that of Carl Hagenbeck, of Hamburg, to be held in high honor by all zoologists and naturalists, although he was not the pioneer, for the open-air treatment and rational display of wild animals in captivity were being begun in many parts of the world while the Thier-Park at Stellingen was still a suburban waste. He has brought a reckless enthusiasm, a vast practical knowledge and a sympathetic imagination to bear on the treatment of living animals, and it would be equally ungenerous and foolish to fail to recognize the widespread and beneficent influence of his example.

However we improve the older menageries and however numerous and well-arranged the new menageries may be, they must always fall short of the conditions of nature, and here I find another reason for the making of zoological sanctuaries throughout the world. If these be devised for the preservation of animals, not merely for the recuperation of game, if they be kept sacred from gun or rifle, they will become the real zoological gardens of the future, in which our children and our children's children will have the opportunity of studying wild animals under natural conditions. I myself have so great a belief in the capacity of wild animals for learning to have confidence in man, or rather for losing the fear of him that they have been forced to acquire, that I think that man, innocent of the intent to kill, will be able to penetrate fearlessly into the sanctuaries, with camera and notebook and

field-glass. In any event all that the guardians of the future will have to do will be to reverse the conditions of our existing menageries and to provide secure enclosures for the visitors instead of for the animals.

I must end as I began this address by pleading the urgency of the questions I have been submitting to you as an excuse for diverting your attention to a branch of zoology which is alien from the ordinary avocations of most zoologists, but which none the less is entitled to their fullest support. Again let me say to you that I do not wish to appeal to sentiment; I am of the old school, and believing that animals are subject and inferior to man, I set no limits to human usufruct of the animal kingdom. But we are zoologists here, and zoology is the science of the living thing. We must use all avenues to knowledge of life, studying the range of form in systematic museums, form itself in laboratories, and the living animal in sanctuaries and menageries. And we must keep all avenues to knowledge open for our successors, as we can not guess what questions they may have to put to nature.

P. CHALMERS MITCHELL

THE EIGHTH INTERNATIONAL CONGRESS OF APPLIED CHEMISTRY

A PRELIMINARY report by Dr. Bernhard Hesse, the secretary of the congress, shows that in the seven days' sessions in New York City, September 6-12, the twenty-four sections of the congress read over five hundred papers, of which about half were discussed. Over five hundred of the papers presented were in print before the congress assembled in New York, thus greatly facilitating their discussion. Every one who has had experience in getting papers into print in advance of a scientific meeting will join in hearty congratulations to the officers of the congress and to its publication committee for this extra-

ordinary feat. Six highly interesting public lectures, by well-known specialists, upon topics of present interest, added to the general attractiveness of the congress. Of the 4,500 members in various parts of the world, 2,173, coming from thirty different countries, were in attendance. The American Chemical Society, the American Institute of Chemical Engineers, the New York branch of the Society of Chemical Industry, the American branch of the Verein Deutscher Chemiker, the American Institute of Mining Engineers and the American Electrochemical Society joined forces with the congress and held joint meetings with the various sections in which they were particularly interested. Such is, in barest outline, a glance at the statistics of the congress.

Of social functions and opportunities for personal intercourse, the congress presented an "embarrassment of riches." Received in a most cordial and genial manner by President Taft on the lawn of the White House, by the secretary and board of regents of the Smithsonian Institution in the new National Museum, by the various scientific bureaus and laboratories of Washington; fêted to the limit of time and capacity in New York City, given a memorable steamer trip up the glorious Hudson, in perfect weather, and finally winding up with two extensive trips of ten and forty days respectively, through the most interesting parts of the United States—each chemist in attendance had the fullest opportunity for feeling welcome, for meeting distinguished colleagues and for seeing the best and most wonderful sights of America.

Of the notable features of the congress, the lecture of Mr. Eyde, the Nestor of the Norwegian saltpeter industry, deserves first place. To probably two thousand people, in the great hall of the Natural History Museum, New York, he told the fascinating story of fixing the nitrogen of the air to nitric acid, in the great Norwegian factories where 250,000 horsepower is harnessed and toiling for this great enterprise. A close second was the lecture on synthetic or manufactured rubber, by Dr. Perkin, of England, the importance of which

product is recognized by every one. Dr. Duisberg, of Germany, who claims the honor of the invention for Germany, showed automobile tires of the new product which had given entire satisfaction, but while Germany has done much in developing the invention, the honor of originating it is recognized as belonging to England. But there are honors enough in recent chemical achievements to go all the way around, and no country represented at the congress was without its contributions to chemical successes to which it could point with pride.

Of the resolutions passed by the congress, one of international significance was the approval of the work of, and the continuance of, the commission to publish annual volumes of newly determined chemical and physical constants. The 1910 volume, just issued, is such a splendid and useful volume, that the commission was authorized to continue its preparation of the 1911 and 1912 volumes. Another resolution authorized the use until 1915 of the published atomic weights of 1912 as the standard official table for commercial purposes, thus putting an end to the confusion caused in chemical industries by the use of atomic weights revised every year. Another resolution aimed at standardizing the strength and purity of pharmaceutical products all over the world; another the establishing of better and standard methods of sampling ores, metals and fuels. Other resolutions of a more technical nature, useful to the chemical industry but hardly interesting to the general scientific public, need not be mentioned.

Speaking for ourselves, as hosts, the advantages and returns to us have been colossal. Always in danger of becoming insular, in spite of our continental proportions, we have now felt the liberalizing contact with notable men of other lands speaking other languages. We have had forced upon us the various points of view, from which other people see, not only chemical questions, but from which they regard the general problems of economics, legislation, labor, industry, commerce and the general well-being of nations and the advance of civilization. And we are enriched

thereby, educated, inspired. Have we not also had the inestimable privilege of seeing, hearing, perchance of conversing with, some of the great lights of science whose names are veritable household words and whose presence among us is of itself an uplift? We now feel that we have a grasp on the best that the world can give us, that we henceforth work together with the master minds of the world towards a common goal, that we are an integral part of the great throbbing universal science-world of which we may have felt, heretofore, that we were only an outlying province or a disconnected branch.

Having spoken for ourselves, may we add, speaking for our guests, and doing them the courtesy of taking their words at par value, that they have been equally benefited. America is a name to conjure with in other parts of the world; it is the land of liberty (perhaps of too much liberty), the abode of the most energetic people on earth (perhaps of the too strenuous), the scene of the most colossal activity ever heard of in history (activity perhaps bordering on hysteria), the locus of engineering feats (sometimes with too low a factor of safety) which challenge the admiration of the rest of the world. Of this wonderful country the foreigner has heard, read and seen pictures until, if he has a spark of imagination, his enthusiastic desire to visit it is almost beyond belief. To many such it is the fond dream of a life time. But the wide Atlantic, or the broader Pacific, lies between and many think of the long sea voyage (so restful and agreeable to most of us) with rising fears. However, having made the decision to come, accepted the sacrifices involved and landed among us, having seen as much as could be crowded into the time available, and then returned to their homes, what is the resultant for these members of the congress?

From a most general point of view, without any pride of land or accomplishment, let us admit that our ever-welcome foreign visitor carries back to Europe and other foreign lands the germ of Americanism. American travelers, writers, scientists, are doing a great deal towards "Americanizing" the rest of the

world, but our foreign visitors, who see us as we are (not as we pretend ourselves to be), with our human failings as well as our almost superhuman achievements, carry back a juster appreciation of the true American spirit—and its frailties make it even more attractive. The intense love of accomplishment, the generous sharing of credit with others, the brushing aside of formalities and cutting of red tape when things are to be done which should be done, the good will and fellowship towards colleagues and co-workers—these are but a few of the attributes of the American spirit which our foreign guests are quick to perceive and appreciate, and not slow to assimilate and to imitate. Shall we not believe them when they speak of these things with admiration, and tell us that these are the most valuable souvenirs they take back with them to their distant homes? And having arrived there does not the leaven still work? I hesitate to think that any of our failings from grace (in the way, for instance, of oppressive monopolies and unfair competition) are thus disseminated through the world—I doubt that they are—but I have no manner of doubt that our observing, appreciative and discriminating visitors from abroad will become active propagandists of the distinctively American virtues which they so disingenuously admit us to possess. Careful observers of conditions in Europe, particularly of those parts of Europe most open to the impress of Americanism, see there plainly this growth of the American spirit, in politics, government, science and particularly in the general attitude of people towards each other and towards their daily life. Our visitors will return to their homes partly "Americanized," in the better, or let us say in the best, sense of that word, and let us not be so falsely modest as to deny these facts.

The next International Congress of Applied Chemistry will be held in Saint Petersburg, in 1915, at a time early enough in the year not to interfere with attendance later at our Panama Exposition in San Francisco. In fact, let us here suggest to American chemists that their program for the jubilee year

1915 should be to attend the congress, travel through Russia and Siberia and cross the Pacific to our great World Exposition, thus combining two unrivaled opportunities, the like of which will never occur again. We are the richest people on earth and the most ambitious; let us also become the best informed and the most cosmopolitan: real "citizens of the world."

J. W. RICHARDS

LEHIGH UNIVERSITY

HENRY ADAM WEBER

HENRY ADAM WEBER, professor in agricultural chemistry, Ohio State University, and widely known as an expert chemist, died at his home in Columbus, June 14, after a brief illness from apoplexy. He had not been well for some months and had not been actively engaged in teaching. He was 67 years old.

Professor Weber was born in Clinton Township, July 12, 1845. He studied at Otterbein University. In 1863 he went to Germany to complete his education and studied at the University of Munich. He was one of the early pupils of the eminent German chemist, Justus von Liebig.

Returning to America, he was given the degree of doctor of philosophy by Ohio State University in 1879. For several years Mr. Weber served as assistant chemist for the Ohio geological survey and then became professor of chemistry in the University of Illinois. He attracted wide attention by experiments in the manufacture of sugar from sorghum and held several patents.

In 1884 he returned to Ohio and became professor of agricultural chemistry at Ohio State University, which position he held until the time of his death, and in which he achieved much work of note in the field of agricultural and food chemistry. He held the position of chief chemist of the state dairy and food commission from 1884 to 1897.

He was a fellow in the American Association for the Advancement of Science, a member of the Chemical Society and the Ohio Academy of Science. He was the first president of the Columbus Chemical Society and

continued in that office several years. Professor Weber served four years on a committee appointed by Dr. Harvey W. Wiley for the standardization of pure foods, and was the author of a course in qualitative analysis that passed through four editions.

THE DEDICATION OF THE RICE INSTITUTE

THE president and trustees of the Rice Institute have arranged an academic festival from October 10 to 13 to dedicate the institution with appropriate ceremonies and to inaugurate the educational program with a series of lectures. These inaugural lectures are as follows:

* Professor Rafael Altamira y Crevea, of Madrid, Spain; late Professor of the History of Spanish Law in the University of Oviedo; Director of Elementary Education in the Spanish Ministry of Public Instruction.

* Professor Emile Borel, of Paris, France; Director of Scientific Studies at the Ecole Normale Supérieure; Editor-in-Chief of *La Revue du Mois*; Professor of the Theory of Functions at the University of Paris.

Senator Benedetto Croce, of Naples, Italy; Life Senator of the Italian Kingdom; Member of various Royal Commissions; Editor of *La Critica*.

* Professor Hugo de Vries, of Amsterdam, Holland; Director of the Hortus Botanicus and Professor of the Anatomy and Physiology of Plants in the University of Amsterdam.

* Professor Sir Henry Jones, of Glasgow, Scotland; Fellow of the British Academy; Professor of Moral Philosophy in the University of Glasgow; Hibbert Lecturer on Metaphysics at Manchester College, Oxford.

Privy Councillor Baron Dairoku Kikuchi, of Tokyo, Japan; late Japanese Minister of Education; formerly President of the University of Tokyo, and later of the University of Kyoto; recently Lecturer on Japanese Education at the University of London.

Professor John William Mackail, of London, England; former Fellow of Balliol College, and late Professor of Poetry in Oxford University.

Privy Councillor Professor Wilhelm Ostwald, of Gross-Bothen, Germany; late Professor of Chemistry in the University of Leipzig; Nobel Laureate in Chemistry, 1909.

The late Professor Henri Poincaré, of Paris, France; Member of the French Academy; Commander of the Legion of Honor; Professor of Mathematics and Astronomy at the University of Paris.

* Professor Sir William Ramsay, K.C.B., of London, England; late Professor of Chemistry at University College, London; Nobel Laureate in Chemistry, 1904; President of the Seventh International Congress of Applied Chemistry.

Professor Carl Störmer, of Christiania, Norway; Member of the Norwegian Academy of Sciences; Associate Editor of the *Acta Mathematica*; Professor of Pure Mathematics in the University of Christiania.

* Professor Senator Vito Volterra, of Rome, Italy; Life Senator of the Italian Kingdom; Dean of the Faculty of Science and Professor of Mathematical Physics and Celestial Mechanics in the University of Rome; recently Lecturer in the Universities of Paris and Stockholm.

Each of these gentlemen has consented to prepare three lectures for the proceedings of the opening festival and to permit the institute to publish his dissertations in a series of volumes which it is proposed to issue in commemoration of the occasion. Those lectures whose names are designated above by an asterisk will be present and read the introductory lectures of their respective courses: the lectures of those whose names are not so designated will be contributed in manuscript and placed upon the program by title.

SCIENTIFIC NOTES AND NEWS

THE eighty-second annual meeting of the British Association, which opened on September 4, had a preliminary registration of 2,379 members, which is considerably larger than the average. At the opening meeting, at which the address of Professor Schäfer, already published in *SCIENCE*, was delivered, it was announced that Mr. J. K. Caird, of Dundee, had given £10,000 to the funds of the association.

DR. SIMON FLEXNER, director of the laboratories of the Rockefeller Institute, has been appointed Huxley lecturer for the current year. This lecture will be given before the

Charing Cross Hospital Medical School, London, on October 31, 1912.

PROFESSOR HUGO DE VRIES lectured at the New York Botanical Garden on September 14.

PROFESSOR WILHELM OSTWALD, who had intended to be present at the opening of the Rice Institute and to lecture at several universities, has been obliged to cancel his American trip, owing to ill-health.

SIR WILLIAM TURNER, professor of anatomy at Edinburgh, and Dr. Julius von Hann, professor of meteorology at the University of Vienna, have been appointed foreign knights of the Prussian order "Pour le mérite."

ALFRED H. BROOKS, geologist in charge of the Alaskan division of the U. S. Geological Survey, has been appointed a member of the Alaskan Railroad Commission, and is now en route to Alaska.

MR. V. H. HUGHES, E.M., has been appointed assistant state geologist of Missouri.

DR. FREDERICK J. BIRCHARD, formerly assistant in chemistry at the Rockefeller Institute, has been appointed a research chemist in the Dairy Division of the Bureau of Animal Industry, Washington, D. C.

THE Board of Scientific Directors of the Rockefeller Institute for Medical Research announce the following appointments: Michael Heidelberger, fellow in chemistry; Linda Bartels Lange, fellow in pathology; Florentin Medigreceanu, assistant resident physician.

A COURSE of two weeks devoted to an extension course in nervous and mental diseases has been given at Fordham University School of Medicine. Among those taking part were Drs. Henry Head and Gordon Holmes, of London; Dr. Carl Jung, of Zurich; Dr. Alwyn Knauer, of Munich; Dr. N. Achucarro, of Madrid, and Dr. Colon K. Russel, of Montreal.

PROFESSOR H. STRAUS, Berlin, will deliver a course of lectures, October 12, 14, 15, on diseases of the stomach and kidneys, at the New York Post-Graduate Medical School, and Professor Dr. Carl von Noorden, physician in

chief of the City Hospital, Frankfort, Germany, a course on pathology and treatment of diabetes, radium therapy and arteriosclerosis, October 28-31 inclusive.

THE REV. ROBERT ASHINGTON BULLEN, the well-known English naturalist, died on August 15, aged sixty-two years.

MR. CLINTON THOMAS BENT, a distinguished British surgeon, known also for explorations in the Caucasus and elsewhere, died on August 26, aged sixty-one years.

DR. FRITZ KÖTTER, professor of applied mathematics at the Berlin Technological Institute, died on August 17, aged sixty-one years.

DR. RUDOLF HÖRNES, professor of geology at Gratz, died on August 20, aged sixty-two years.

THE fourth National Conservation Congress will be held at Indianapolis on October 1, 2, 3 and 4, under the presidency of Mr. J. B. White, of Kansas City, Mo.

THE late Mr. Allan Octavian Hume, known as an ornithologist and botanist, bequeathed about £14,000 to the South London Botanical Institute, to which in 1907 he gave £10,000.

THE late Professor Lombroso offered every second year in connection with the *Archiv d'Anthropologia Criminale* a prize of Fr. 500 for the best work in connection with criminal anthropology. His family have now offered to the organization committee of the Eighth International Congress of Criminal Anthropology a prize of Fr. 1,000 for the best work reported to the congress which is to be held in Budapest in the summer of 1914.

A DESPATCH received from the American ambassador to Brazil relative to the approaching eclipse of the sun (October 10 next), which will be visible in that country states that: "The Brazilian minister of agriculture, desirous of assisting the foreign astronomical expeditions which propose to observe the eclipse, has petitioned the federal congress to appropriate \$23,000 for their reception and entertainment. He has also requested that their professional instruments and private

effects may be granted the privilege of free customs entry, that repairs to their instruments may be made in government workshops and that railroad passes and telegraphic franks may be given them. It is probable that the federal congress will act favorably upon the minister's petition, which has already received the endorsement of the executive."

THE sundry civil bill, as passed by the last session of congress, contained an appropriation of \$1,440,520 for the U. S. Geological Survey. Most of the appropriations for the survey are included in this great government supply bill, but in addition to the above amount \$37,400 was appropriated in the "legislative bill," for rents, so that the total amount appropriated is \$1,477,920. The principal items in the appropriations for the Geological Survey for the fiscal year ending June 30, 1913, are as follows:

Topographic surveys	\$350,000
Geologic surveys	300,000
Mineral resources of Alaska	90,000
Mineral resources of the United States	75,000
Chemical and physical researches	40,000
Geological maps of the United States	110,000
Gauging streams, etc.	150,000
Surveying national forests	75,000

The bill also appropriates \$145,000 for printing and binding survey reports, to be expended by the public printer.

A REMARKABLE deposit of remains of extinct animals is now to be explored by the University of California. This is the fossil beds in the Rancho La Brea, in the outskirts of Los Angeles. There oil has oozed to the surface, and in the tar pools so formed animals have become mired and have lost their lives, and their skeletons, even to the most fragile portions, have been preserved. Madam Ida Hancock Ross, the owner of the Rancho La Brea, has given to the university the privilege of excavating these fossil beds, and work has just begun, under the direction of Dr. John Campbell Merriam, professor of paleontology and historical geology.

THE American Fisheries Society at its recent annual meeting passed the following resolutions:

WHEREAS, the Congress of the United States has passed an act to give effect to the convention between the United States, Great Britain, Russia and Japan, having for its primary object the suppression of pelagic sealing, and

WHEREAS, this measure was amended so as to establish a five-year closed season on male seals on the Pribilof Islands, contrary to the advice of the United States Bureau of Fisheries and its Advisory Board, including the best informed scientists of the country, all personally familiar with the islands and the fur seal problem, and contrary to the expressed opinion of others personally familiar with the conditions of seal life on the islands.

Therefore, be it *Resolved*, that the American Fisheries Society places on record its deep regret that congress should have acted contrary to the advice of the recognized authority in this country on such matters, and further,

Resolved, that this society recommend the early repeal of this provision which is contrary to all biological experiences and which can lead only to dissatisfaction and to the ultimate exploiting of seal fisheries by private interests and with detriment to the herd, consequent financial loss to the government, and loss of prestige to the nation.

THE following is the text of the act of congress concerning the Public Health Service:

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Public Health and Marine-Hospital Service of the United States shall hereafter be known and designated as the Public Health Service, and all laws pertaining to the Public Health and Marine-Hospital Service of the United States shall hereafter apply to the Public Health Service, and all regulations now in force, made in accordance with law for the Public Health and Marine-Hospital Service of the United States shall apply to and remain in force as regulations of and for the Public Health Service until changed or rescinded. The Public Health Service may study and investigate the diseases of men and conditions influencing the propagation and spread thereof, including sanitation and sewage and the pollution either directly or indirectly of the navigable streams and lakes of the United States, and it may from time to time issue information in the form of publications for the use of the public.

Sec. 2. That beginning with the first day of October next after the passage of this act the salaries of the commissioned medical officers of the Public Health Service shall be at the following rates per annum: surgeon general, six thousand dollars; assistant surgeon general, four thousand dollars; senior surgeon, of which there shall be ten in number, on active duty, three thousand five hundred dollars; surgeon, three thousand dollars; passed assistant surgeon, two thousand four hundred dollars; assistant surgeon, two thousand dollars; and the said officers, excepting the surgeon general, shall receive an additional compensation of ten per centum of the annual salary as above set forth for each five years' service, but not to exceed in all forty per centum: *Provided*, That the total salary, including the longevity increase, shall not exceed the following rates: assistant surgeon general, five thousand dollars; senior surgeon, four thousand five hundred dollars; surgeon, four thousand dollars: *Provided further*, That there may be employed in the Public Health Service such help as may be provided for from time to time by congress.

DR. ROLLIN T. CHAMBERLIN, of the department of geology in the University of Chicago, recently returned from a year of special investigations in South America, where he went as a geologist of the Brazilian Iron and Steel Company to examine the recently recognized iron ore deposits in the state of Minas Geraes, famous in the past for its output of gold and diamonds but likely in the future to be best known for its unrivaled mountains of iron ore. Dr. Chamberlin's special work was to locate the most promising ore masses in the district, make geologic and topographic surveys, and estimate the quantity and value of the ore. The surveys were much hindered by the necessity of cutting trails through the tropical jungle, natives armed with the Brazilian foica or wood hook being employed for the purpose. Travel was largely by mule-back. In order to get a general view of the geology of the South American continent Mr. Chamberlin, after finishing his work in Minas Geraes, traveled southward through Brazil and Uruguay to Buenos Aires and returned to the United States by way of the Straits of Magellan, Chile, Bolivia, Peru and Panama.

PROFESSOR WARREN K. MOOREHEAD, curator of the department of archeology, Phillips Academy, Andover, Mass., reports that the survey of which he had charge finished its first year in Maine September 8. There were on the expedition at various times from eight to twelve men and nearly all of the Penobscot valley was examined and mapped. A great deal of work was carried on at Passadumkeag, 40 miles above Bangor, and at Lake Alamoosook, 5 miles south of Bucksport. At Passadumkeag one undisturbed cemetery was entirely dug out and at Alamoosook two cemeteries, and at Orland a fourth was found. In these four cemeteries were 170 graves and from these about 800 stone objects were recovered. These graves contained large quantities of red ochre—not the small particles often encountered in exploration in the west and south—but quarts, or in several instances more than a peck of bright pigment. The objects found in the graves vary from one or two to nineteen in number, and comprise the true gouge, various modified forms of gouges, stone celts and hatchets (usually squared) and long tapering and fluted gouges. There were also some unknown forms, particularly at Passadumkeag, where long oval stones were found. These are perforated, and several exceed a foot in length. The absence of grooved axes, of pottery and bone and shell objects, of pipes, etc., indicates the presence of a culture different from that of the Algonkin. Save in one instance, there were no human bones discovered, and the graves are so old that the stone objects themselves have frequently begun to disintegrate. Mr. Charles C. Willoughby, twenty years ago, opened three burial places in southern Maine and met with similar conditions. Professor Putnam and Mr. Willoughby considered the graves extremely old. The name “the red paint people” has been applied to this culture, temporarily.

THE National Bureau of Standards in its general investigation of structural materials is engaged, among other things, in the determination of the physical properties of concrete. At the suggestion of engineers and

others, the Bureau of Standards is investigating the cause of cracking in concrete structures, where the necessity for expansion and contraction joints is questioned. For this purpose, reference marks were placed last week on some of the typical old and new concrete work in Wayne County, Michigan, also at Greenwich, Connecticut. Measurements will be taken from time to time during the summer and winter to determine the expansion or contraction in the concrete caused by temperature variations and the changes of volume which take place during the hardening of the concrete. Similar reference marks are being placed on the lock walls of the Panama Canal and various other structures.

THE United States has held first place among the coal-producing countries of the world since 1899, when this country supplanted Great Britain. In 1911 the total world's production of coal amounted to approximately 1,302,500,000 short tons, of which the United States contributed 496,221,168 tons, or 38.1 per cent. according to the United States Geological Survey. In the 12 years from 1899 to 1911 the production of the United States has increased over 250 per cent.; from 1899 to 1911 Great Britain has increased its output about 50 per cent., from 198,146,731 to 304,521,195 tons. The United States in 1911 produced almost 500,000,000 tons, or 63 per cent. more than Great Britain in 1911; Germany's production of coal and lignite in 1899 was 93,640,500 short tons; in 1911 it was 258,223,763 tons, an increase of over 175 per cent. The combined production of Great Britain and Germany in 1911 was 562,744,958 short tons, which exceeded the output of the United States by only 66,500,000 tons, or 13.2 per cent. These three countries, United States, Great Britain and Germany, produce more than 80 per cent. of the world's total supply of coal.

SECRETARY WILSON, of the U. S. Department of Agriculture, has decided to establish an experiment station on the Manti National Forest near Ephraim, Utah, for the study of grazing and water protection problems. In fact bids for the construction of the necessary

buildings have been received and it is expected to have the station in working order before winter. Already the gathering of observations on the relations of erosion and run-off to the forest cover have begun. The Manti National Forest was chosen as the site for this experiment station because it offers exceptionally good opportunities for investigating problems of practical value in connection with regulated grazing. Ephraim and other towns in its neighborhood have suffered severely from floods following violent rainstorms in the mountains, and it has already been proved conclusively that the overgrazed condition of areas on which the natural vegetative cover has been seriously altered is responsible for the formation of torrents and the rapid discharge of debris-laden floodwaters. In a recent destructive storm the water ran clear from a part of the watershed which was within the National Forest, and in good condition as a result of well-regulated grazing, while from other areas it swept down sand and boulders. One of the objects of the study will be to learn how the maximum of grazing use of natural forest land can be obtained without injury to forest reproduction and stream flow. The national forests provide range during a part or all of the year for a considerable part of the stock produced in the western states. Approximately one and one half million head of cattle and horses and seven and one half million head of sheep and goats occupy the forest lands each year. These figures do not include nearly three hundred thousand calves and over four million lambs and kids for which permits are not required. The experts of the department believe that when the ranges which were denuded by many years of improper use are restored to a normal condition of productivity it will be possible to provide feed for a much larger number of stock without injury to forest growths or watersheds, and both the stockgrower and the consumer of meat products will thus be benefited. Consequently every effort is being made to determine practicable means of regenerating depleted ranges. All of the studies which are about to be initiated have this point in view.

UNIVERSITY AND EDUCATIONAL NEWS

HARVARD UNIVERSITY and Middlebury College will each receive ultimately half of \$125,000, left by Daniel A. Kimball, of Stockbridge.

THE heirs of Michael Cudahy have given \$10,000 toward the endowment fund of Newman Hall, at the University of California, and \$1,000 each has been given by four other donors. The Newman Club is an organization of the Roman Catholic students of the university. Through the generosity of Archbishop Patrick W. Riordan, of San Francisco, who contributed \$40,000 (from his "jubilee fund"), and through the aid of other friends, the club occupies Newman Hall, an admirably appointed building, which contains meeting rooms, a chapel, a library, bowling alleys, social rooms, a kitchen, etc., and which serves as a center for the social and religious life of the Catholic students. Its privileges and hospitalities are open also to the other students of the university.

DR. DON R. JOSEPH, formerly associate in physiology and pharmacology at the Rockefeller Institute, has been appointed associate professor of physiology at Bryn Mawr College.

THE following new appointments have been made at Toledo University: Oscar William Irvin, B.S. (Kentucky), professor of mechanics and physics; Rudolf Pintner, M.A. (Edinburgh), Ph.D. (Leipzig), professor of psychology and education.

THE following appointments have been made to the staff of Macdonald College, Ste. Anne de Bellevue, Quebec: Wilfrid Sadler, M.D.D., of the Midland Institute, Kingston, Derbyshire, England, assistant in bacteriology; D. W. Hamilton, Ph.D., of the New Brunswick Normal School, assistant in physics; W. M. Aikenhead, B.S.A., assistant in horticulture; Alex. R. Ness, B.S.A., assistant in animal husbandry. Professor W. Saxby Blair has resigned the chair of horticulture and accepted the position of superintendent of the Kentville, Nova Scotia, Experimental Fruit Farm and dominion maritime horticulturist. The following graduates have been

appointed district demonstrators, local representatives of the college, whose function is to promote interest in scientific agriculture and to advise farmers on scientific questions: G. W. Wood, L. C. Raymond, A. A. Campbell, L. V. Parent, R. Newton.

DISCUSSION AND CORRESPONDENCE

A NEW MATHEMATICAL PRIZE

ALFRED ACKERMANN-TEUBNER has founded a new mathematical prize by establishing a capital of 20,000 Marks at the University of Leipzig. For the present a prize of 1,000 Marks shall be given every other year, and the surplus interest shall be added to the capital until this amounts to 60,000 Marks. After the capital has reached 60,000 Marks all the interest, less expenses, shall be used for an annual prize, which shall be given for published work in the domain of the great German mathematical Encyclopedia.

The donor of the capital for the prize reserves the right to bestow it in 1914, without any restrictions; but after this date the prize is to be awarded, in order, for work in the following subjects: (1) History, philosophy, teaching and education; (2) mathematics, especially along the lines of arithmetic and algebra; (3) mechanics; (4) mathematical physics; (5) mathematics, especially along the line of analysis; (6) astronomy, theory of probability and theory of errors; (7) mathematics, especially along the line of geometry; (8) applied mathematics not provided for in what precedes, especially geodesy and geophysics.

Those who have received the Nobel prize shall not be considered in connection with the awarding of this prize and preference is to be given to German mathematicians, but the prize shall not be restricted to the scholars of this nationality. As long as the prize is awarded every second year, papers or monographs which have appeared during the preceding sixteen years may be considered, but only those which have been published no longer than eight years can be considered when it is awarded annually.

The prize is to be awarded for work which exhibits a prominent advance along scientific or pedagogic lines, and the limits of the subject matters to be considered shall, in general, be those of the German encyclopedia. If new penetrating mathematical theories should arise, work along these lines may also be considered. Alfred Ackermann-Teubner is at present the senior member of the great publishing firm of B. G. Teubner, of Leipzig, Germany, and has for many years taken an active part in various mathematical activities. The capital for the prize mentioned above is a consequence of the friendly relations between the donor and various prominent mathematicians.

It is probably fortunate that these prizes are to be given for work already published and not for competing memoirs relating to subjects proposed by some committee. Many of the leading mathematicians do not enter into the race of preparing competing memoirs, and it seems likely that more good will be done if mathematicians feel free to pursue those lines in which they can work most successfully. The subject of mathematics has become so broad that real progress calls for forward movements in many fields. All the various helpful interrelations can not be foreseen by a few men.

G. A. MILLER

SCIENTIFIC BOOKS

Monographs on Biochemistry. The Chemical Constitution of the Proteins. Part I. Analysis. By R. A. H. PLIMMER, D.Sc. Second edition. London and New York, Longmans, Green and Co. Pp. x + 188. 1912. 5 s. 6 d. net.

Although the knowledge concerning the chemical constitution of the proteins gained since the appearance of the first edition of this monograph is relatively small, the amount of information contained in this second edition is much greater than that furnished in the first. The author now gives us a more detailed account of the methods of hydrolysis of the proteins and the estimation of the amino-acids which result thereby. The

chemical constitution of their constituent amino acids is extensively discussed and the methods by which each of these amino acids has been synthesized is described. The differentiation of the proteins by means of the proportion of the various types of nitrogen which they yield on hydrolysis is given in detail, as well as the recent methods for estimating amino nitrogen and also the nitrogen belonging to the different groups of amino acids.

The book contains the first practically complete compilation yet published of analyses thus far made of the products of hydrolysis of all the various individual proteins, a feature which will be appreciated by those working in this field of protein chemistry. In commenting on these analyses the author very properly emphasizes the fact that the percentages reported are in almost all cases minimal, and that none of the analyses represents the true amino acid make-up of the protein; a fact too often overlooked by those who have previously attempted to compile such analyses, which simply reveal gross differences between proteins of different origin.

Plimmer's monograph, like the others of this series, contains a very full bibliography; but, unfortunately, references in the text are not made in such a way as to readily show the papers which are authority for the statements made. This defect is especially apparent in connection with the tables of analyses of the proteins. Those who wish to quickly and pleasantly inform themselves of what is known of the chemical constitution of the proteins, and of the methods by which this has been learned, will find this monograph exceedingly satisfactory. As an experienced teacher of physiological chemistry recently wrote the reviewer, "It strikes me as a remarkably useful book; and it has more human touches than most reviews of this type."

THOMAS B. OSBORNE

Physiologisches Praktikum für Mediziner.
By MAX VERWORN. Second edition. Jena, Gustav Fischer. 1912. Pp. xii + 262; 141 illustrations.

It is a curious fact that Germany, the country in which the science of physiology has undergone its greatest development, has been backward in providing laboratory instruction in that science. And now that it is being provided it is to be regretted that it is on a lower pedagogic and scientific plane than in the English and especially the American universities. The book before us is a second edition from Bonn of a work, the first edition of which was issued from Göttingen five years ago. It is a combination of the chemical and the physical, about one fourth of the text being devoted to the former. There is an average of one illustration for less than two pages of text. Each main topic is introduced by a brief, concise and usually excellent summary of its physiology, and this is followed by an elaborate account of the procedures to be pursued in performing a series of selected experiments. Most of the experiments are well known to university teachers of the subject; but some are new, and a perusal of the book will prove suggestive. Many experiments which are frequently performed by students in American universities are wanting, and the only mammals employed, besides man, are the rabbit, the guinea-pig and the white rat. But the most striking feature of the book is the elaborateness of the directions for laboratory work, something with which we in America are not familiar. The student is never left to determine a procedure for himself, but is told exactly how to do the thing desired. He must, for example, hold his scalpel thus and so, the verbal directions being supplemented by a nearly life-sized picture of a hand holding the instrument; and he must make "not little, shallow, short, hurried cuts with the point of the knife, but long, firm, quiet, deep incisions with its blade." In order to tell how to make a frog's muscle-nerve preparation two pages of text are required and two additional pages of life-sized illustrations. Eight pages, including illustrations, are employed in describing the customary method of measuring the blood pressure in a mammal with the simple action of the vagus nerve on

the blood pressure, the simple action of atropin on the heart, and final asphyxia. One can not examine the book without recalling Mr. Abraham Flexner's discussion of physiological instruction in Germany in his valuable report to the Carnegie Foundation on medical education in Europe. He says:

The practical course in Germany is a thing by itself, and is still unsatisfactorily carried on. . . . Consisting as it does of certain exercises specified and minutely described in a syllabus, the practical course tends to be an isolated series of experiments mechanically executed rather than a stimulating and successful application of scientific method to physiological problems. . . . If, then, physiology is to be taught as an experimental science, as a science of function, the student must be allowed to run risks, to calculate, to observe, to verify, to conclude. Eliminate risk and the experiment becomes a mechanical toy: it may amuse, it does not discipline.

FREDERIC S. LEE

COLUMBIA UNIVERSITY

Short Course in Electrical Testing. By MORECROFT and HEHRE. New York, D. Van Nostrand Company. 1911. Pp. 154. Price, \$1.50 net.

This book is designed primarily for the use of students of other branches of engineering than electrical engineering. As such students are usually none too well versed in the theory of electrical engineering, due to the short time available for the study of this subject, the authors have included with the description of the experiments a brief statement of the more important principles involved. This feature should appeal to any teacher giving laboratory instruction in electrical engineering to students of another department.

The direct current experiments described deal with the measurements of the resistance of wires, of lamps and of the dynamos; the characteristics of the shunt and of the compound generator; the characteristics of the shunt and of the series motor, and the parallel operation of shunt generators and of compound generators. The alternating current experiments deal with determination of wave shape; phase displacement and

power; the effect of inductance, capacity and frequency; the regulation of an alternator; transformer losses; characteristics of the induction and synchronous motors, and of the rotary converter; the parallel operation of alternators, and currents, voltages and power in three-phase circuits.

At the end of each experiment is given a number of questions concerning the principles involved and the reasons for the behavior of the various types of machines. It is to be regretted that the authors have not included in these queries more questions designed to bring out the bearing of the various characteristics upon the commercial application of the machines. Particularly for non-electrical students is it desirable, both for its inherent value and to keep the interest of the students, to bring out repeatedly the uses of the various types of machines and the features limiting their application. In some of the questions the premises are only partially stated. For example, on page 65, is the following: "Explain . . . why a series motor of the same horsepower rating as a shunt motor exerts a greater full load torque." In this connection, it may also be noted that nothing is said as to the difference in the methods of rating shunt and series motors. In fact, the question of rating and temperatures seems to be omitted entirely from the book.

In the alternating current section there are certain features which are not altogether desirable. In the first place the clockwise system of vector notation is employed. Again, the terms "impedance" and "reactance" seem to be avoided, although frequent mention is made of "conservative" and "dissipative" reactions, inductance and capacity reactions, etc. It is also to be regretted that the authors have given no index to the book.

The experiments selected and the directions given are in the main entirely satisfactory. On the whole the book should prove very useful for the purpose for which it is primarily intended, i. e., a laboratory manual for non-electrical students.

HAROLD PENDER

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

SCIENTIFIC JOURNALS AND ARTICLES

THE July number (volume 13, number 3) of the *Transactions of the American Mathematical Society* contains the following papers:

J. B. Shaw: "Quaternion developments with applications."

H. S. Vandiver: "Theory of finite algebras."

Dunham Jackson: "On the degree of convergence of the development of a continuous function according to Legendre's polynomials."

Louis Ingold: "Functional differential geometry."

E. B. Van Vleck: "On the extension of a theorem of Poincaré for difference equations."

E. B. Van Vleck: "One-parameter projective groups and the classification of collineations."

J. E. Rowe: "Bicombinants of the rational plane quartic and combinants of the rational plane quintic."

THE closing (July) number of volume 18 of the *Bulletin of the American Mathematical Society* contains: Report of the April meeting of the Society, by F. N. Cole; "Proof of a theorem due to Picard," by W. R. Longley; Review of Chwolson's *Traité de Physique*, by E. B. Wilson; "Arithmétique Générale," by E. Dumont and N. J. Lennes; Shorter Notices: Muir's Determinants, by G. A. Miller; Cohen's Lie Theory of One-Parameter Groups, by E. J. Wilczynski; Müller's *Abriss der Algebra der Logik*, by L. I. Neikirk; Andoyer's *Cours d'Astronomie*, by Kurt Laves; "Notes"; "New Publications"; List of papers read before the society and subsequently published; Index of Volume 18.

NOTES ON ENTOMOLOGY

SOME years ago Dr. Y. Sjöstedt made a collecting trip to the high mountains of East Africa. The results of nearly a year's collecting in that region were gradually published, and now have all been brought together in three volumes.¹ Dr. Sjöstedt collected over 50,000 specimens of insects, belonging to about 3,500 species, of which over 1,200 were new

¹"Wissenschaftliche Ergebnisse der Schwedischen Zoologischen Expedition nach dem Kilimandjaro, dem Meru, und dem umgebenden Massaiesteppen Deutsch-Ostafrikas, 1905-1906, unter Leitung von Professor Dr. Yngve Sjöstedt," Stockholm, 1911, 4to.

species. Many new genera and several new families have been erected upon this material, one of the richest insect collections ever brought from Africa.

A NEW entomological journal is the *Entomologische Mitteilungen* issued by the Deutsche Entomologische Museum, under the direction of Drs. S. Schenkling and C. Schaufuss. It is to be a monthly, and will contain papers on all orders of insects, but doubtless a majority will be on beetles. The first number contains a short history of the Deutsche Entomologische Museum, the only purely entomological museum in the world. With this new publication the museum abandons its previous quarto journal.

ONE of the results of the Belgian exploitation of the Congo was a Congo Museum, located near Brussels. This institution has now begun the issuance of a journal, *Revue Zoologique Africaine*, edited by the curator of the museum, Dr. H. Schouteden. It is to be issued irregularly; two fascicles have appeared, and are largely occupied with entomological articles treating all orders of insects.

DR. E. M. WALKER, who for some years has been studying the dragonflies of the genus *Aeshna*, has now published his results.² It is a most painstaking and excellent work. There is a considerable amount of biologic information about these insects in the early part of the article, as well as figures of the characteristic parts of the nymphs. The author recognizes and gives complete descriptions of 16 species, most of which are confined to the northern parts of the United States and Canada. Several of the plates represent the markings of the body in color.

THE position of the flies of the family Phoridae in the system of the Diptera has been a subject for discussion for many years. It has generally been considered as on the borderland between the two main divisions of the order, put sometimes on the one side, sometimes on the other. Now Dr. D. Keilin has

²"The North American Dragonflies of the Genus *Aeshna*," Univ. of Toronto Studies, No. 11, pp. 213, 28 plates, 1912.

made a careful study of the larvæ of three species and unhesitatingly places the family in the Cyclorhapha.³ These three species of *Phora* he found breeding in decaying snails, and each can be recognized in the larval and pupal condition. The author also investigates the internal anatomy of the larvæ and pupæ, and the methods of emergence of the flies.

The full paper⁴ in which Frederic Muir solves the *Ascodipteron* question has recently been issued; a brief preliminary note appeared a year ago. Mr. Muir kept the bats containing parasites, and obtained puparia, which after about a month disclosed the winged flies. After mating, the female attaches to the bat, breaks off her wings and legs, and by the aid of the powerful mouth-parts burrows until only the tip of her abdomen remains extruded. Her body enlarges until the head is hidden within a deep anterior pit. Both new species are from the Malay region.

A RECENT entomological portion of "Das Tierreich" is by Dr. H. Friese on the megachilid bees of the world.⁵ The author tabulates the species according to the main geographical regions. Most of the species are from Europe or North America; the tables of the European species are doubtless fairly complete, but the tables for the American forms will be greatly enlarged, as many of our species are yet undescribed. In *Osmia* Dr. Friese lists 345 species, in *Anthidium* 247 and in *Megachile* 540. The work should be of great help to any one who would undertake the careful study of our megachilid bees.

ONE of the largest parts of the new "Coleopterorum Catalogus" is No. 39 on the subfamily Cerambycinae, 574 pages. It will be of the greatest use to the numerous students of this, one of the most popular families of

³"Recherches sur la morphologie larvaire des Dipteres du genre *Phora*," *Bull. Sci. France Belg.*, XLV., pp. 27-88, 1911, 4 pls.

⁴"Two New Species of *Ascodipteron*," *Bull. Mus. Comp. Zool.*, LIV. (No. 11), pp. 331-366, 3 pls., 1912.

⁵"Das Tierreich," 28 Lieferung, Apidae I Megachilinae, 1911, 440 pp.

beetles, as its author, Dr. Aurivillius, is well known as a most careful and thorough worker. In many of the larger genera the species are arranged according to the main zoological regions.

NATHAN BANKS

SPECIAL ARTICLES

SHEEP-BREEDING EXPERIMENTS ON BEINN BHREAGH¹

Introductory Remarks.—It is astonishing how ignorant we all are about common things. Just test the matter on yourself. Sheep are quite common; and we are all more or less familiar with their appearance, and should therefore be able to answer some questions about them. Well then—*How many front teeth has a sheep got in its upper jaw?*

You never counted them? You have not observed? Next time you come across a sheep just look and see, and you will find that she has *none at all!*—the upper gum is bare.

We are all familiar with the fact that a sheep suckles her young; and know therefore that she possesses nipples that yield milk. How many nipples has she, and where are they located?

Human beings, of course, have only two, located on the breast. Dogs and cats and other mammals that have a litter at birth have many nipples, located in pairs all along the belly. Cows have at least four, located on the belly between the hind legs. Where are the sheep's nipples placed, and how many are there?

I must confess that I was myself unable to answer these questions, until, in the year 1890, I made a personal examination of the sheep on Beinn Bhreagh.

¹From the *Beinn Bhreagh Recorder*, Vol. X., pp. 368-386: A typewritten periodical, limited to five copies, containing records of experiments of various kinds, conducted at Dr. Bell's summer place at Beinn Bhreagh, near Baddeck, Cape Breton Island, Nova Scotia.

One copy is deposited in the Smithsonian Institution, at Washington, D. C., and the others are in the possession of private individuals, viz., Dr. A. Graham Bell and Mr. J. G. Davidson at Beinn Bhreagh, N. S., and Mr. Gilbert H. Grosvenor and Mr. David C. Fairchild, at Washington, D. C.

It then became obvious that sheep, like human beings, have only two nipples; and that they are located, as in the case of the cow, on the belly between the hind legs.

It was also found at this examination in 1890 that some sheep have four nipples instead of two. Two of these were in the usual place and of the usual size; the extra pair lay in front, upon the belly; and the nipples were extremely small and undeveloped, more nearly resembling pimples upon the skin than nipples. They were embryonic in character and yielded no milk.

At once interesting questions began to arise: Could we, by mating four-nippled ewes with four-nippled rams, and by selecting from their progeny for breeding purposes the lambs in which the extra nipples were most fully developed, gradually create a variety of sheep that would have four nipples of equal size, all yielding milk?

If we could, by selection, create a four-nippled variety of sheep, why not a six-nippled, an eight-nippled, or a multi-nippled variety?

It was also found in 1890 that the proportion of sheep having four nipples was larger among the twin-bearing than the single-bearing ewes; and this at once raised the question as to whether there was any correlation between the number of nipples and the number of lambs at a birth.

If the four-nippled variety should turn out to be twin-bearing, as a rule, would the six-nippled and eight-nippled varieties give us triplets and quadruplets; and would the multi-nippled ewes have a litter at birth?

Twins, etc., are usually smaller at birth than single lambs, even after they have become mature, probably because their mothers are unable to supply sufficient milk for two or more lambs when the ewes have only two functional mammae.

Would a sheep supply more milk from four functional nipples than two; and if so, would she be able to care for two lambs as easily as one?

A twin-bearing stock, able to rear twins successfully, would undoubtedly be of great value in a country like Nova Scotia, where the win-

ters are long and the cost of sheep-breeding correspondingly great. If the farmers could raise two lambs instead of one for every ewe wintered, sheep-breeding in Nova Scotia might become a profitable industry of great importance.

These considerations led to the sheep-breeding experiments upon Beinn Bhreagh. I must here express my indebtedness to Mr. J. G. Davidson, Superintendent of Beinn Bhreagh Nursery, who has, for the last ten years, had charge of the experiments under my direction.

A Four-nippled Variety of Sheep.—By pursuing the plan of selection outlined above, we succeeded in producing upon Beinn Bhreagh, in a very few years, a four-nippled variety of sheep in which the ewes had, as a normal condition, four nipples of nearly equal size, all yielding milk.

So few cases of reversion to the ordinary two-nippled type appeared among the lambs that I felt justified in bringing the matter to the attention of the National Academy of Sciences, at their meeting in Washington, D. C., April 21, 1904.² At the same time I presented to the National Academy of Sciences, in pamphlet form, the "Sheep Catalogue of Beinn Bhreagh, Victoria County, Nova Scotia, showing the origin of the Multi-nippled Sheep of Beinn Bhreagh, and giving all the descendants down to 1903."³

This four-nippled breed was not slowly evolved by the persistent mating together of sheep having extra nipples of embryonic character. *It sprang suddenly into existence*; for it was soon discovered that it was possible to pick up here and there, from the farmers of Cape Breton Island, ewes with four functional mammae already fully developed. These were added to our flock and hastened the accomplishment of the result.

In a few years after the experiments were begun in 1890, we had so many four-nippled sheep that we were able to cut down the flock

² See SCIENCE, Vol. XIX., p. 767.

³ This pamphlet may be found in many public libraries; the Library of Congress, Washington, D. C., Boston Public Library, the Library of the British Museum.

severely. We killed or sold all sheep with extra nipples in an embryonic or undeveloped form, and limited ourselves to ewes with four functional nipples alone.

After this point had been reached there were very few cases of reversion to the two-nippled type.

The flock speedily increased in numbers, and when, in process of time, it became largely composed of four-nippled sheep whose parents had also been four-nippled, the cases of reversion practically ceased and the breed was established.

At first it appeared that the four-nippled ewes were less fertile than ordinary sheep, for they had a smaller proportion of twins; but this turned out to be due to the fact that the process of selection had necessarily resulted at first in a flock composed mainly of young ewes, and young sheep rarely have twins. After the four-nippled ewes had grown to full maturity they were found to be as fertile in this respect as ordinary sheep, if not more so.

Most of the twins that were born on Beinn Breagh were small at birth. In the autumn, however, they were found, upon the average, to be fully equal in size and weight to the single lambs of the flock, thus demonstrating the important point that a breed of sheep had been produced *which could successfully rear twins*.

During the process of the establishment of the four-nippled breed the number of two-nippled and three-nippled lambs born in the flock gradually decreased; and five-nippled lambs took their place in increasing numbers. Then six-nippled lambs were produced, followed by the occasional appearance of seven-nippled and even eight-nippled lambs, indicating the possibility of producing breeds of sheep with a greater number of nipples than four, if desired.

Since the year 1890, the nipples of several thousand sheep on the island of Cape Breton have been examined, with the discovery that three-nippled, four-nippled and even five-nippled sheep are by no means uncommon. Six-nippled sheep, on the other hand, are extremely rare, only two having been discovered in twenty-two years which were not connected

with our flock. We have never come across a seven-nippled sheep that was not descended from Beinn Bhreagh stock; and eight-nippled sheep seem to be quite unknown at present outside of Beinn Bhreagh.

The fact that four-nippled sheep, like black sheep, are to be found in every flock of considerable size, led me to push the selection in the Beinn Bhreagh flock towards the formation of a six-nippled variety, so as to secure a breed that could not be easily duplicated elsewhere.

Origin of the Six-nippled Variety of Sheep. (Ewe No. 76.)—As early as 1891 we discovered in the flock of a farmer a six-nippled ewe, with the four extra nipples very poorly developed. We purchased her and added her to our flock as "No. 76," as she was a yearling at the time.

She remained on Beinn Bhreagh for several years and gave us nine lambs in all before she died. She was mated with our best four-nippled rams, but never gave us a six-nippled lamb. The first six-nippled lamb born on Beinn Bhreagh, however (No. 610), was her direct descendant (granddaughter) without any admixture of other six-nippled blood; and the ewe, No. 610, gave us a six-nippled lamb when she was only a year old herself.

No. 76 was a white ewe, and in 1893 she was mated with a white ram, but the lamb she produced in 1894 was black. He turned out to be a ram with four nipples (No. 417), and he is largely responsible for the black blood that afterwards appeared in the Beinn Bhreagh flock.

(Ewe No. 256.)—In the course of that same year (1894) we heard of another six-nippled ewe which had been discovered in the flock of a farmer near North River, St. Ann's; but she was so wild that the people on the farm were unable to catch her for us.

As we desired to secure her before the breeding season arrived, we sent a man to the farm two or three times to assist in her capture, but all without success. She was as wild as a deer and leapt the fences and escaped to the woods.

Finally a large expedition was sent about October, 1894. The hunt occupied the greater part of a day, and at last the men succeeded in driving the ewe into a place from which there was no escape, and she was brought to Beinn Bhreagh and added to our flock as No. 256.

She turned out to be a black ewe, two years old, with six well-developed and functional nipples, well arranged in pairs. She was mated with the black ram No. 417 (the offspring of the other six-nippled ewe No. 76), so that any lamb she might have would combine the blood of the two six-nippled ewes, No. 76 and No. 256.

Of course the results of the union were eagerly looked for, but in the spring of 1895 the ewe, No. 256, escaped and lambed in the woods.

Then there was a hunt to save the possibly six-nippled lamb from the foxes that had occasionally taken toll of our flock. It took quite a large number of men, in skirmishing order, to re-capture the run-away, but the lamb turned out, after all, to be a black ewe *with only four nipples!*

Although the black six-nippled ewe (No. 256) lived for many years on Beinn Bhreagh, and gave us twelve lambs in all (including, by-the-bye, five sets of twins) we never got a six-nippled lamb from her—unless indeed her lamb No. 940 might be so considered.

This lamb (No. 940) was at first noted as a five-nippled ewe; but one of her nipples, instead of being round like the others, was greatly elongated in cross section, and had two distinct orifices. It was evidently formed by the union of two distinct nipples into one. After lambing, both of the Siamese-twin nipples were found to yield milk; and we have the ewe now recorded on our books as a six-nippled sheep.

In the autumn of 1895 the black six-nippled ewe No. 256 was again mated with the black four-nippled ram, No. 417; and in the spring of 1896 gave us black twins; one, a female with four nipples, and the other a male, No. 626, with five nipples.

This five nippled ram, No. 626, not only represented an advance in nipples over rams formerly employed; but, in addition, he combined in his own person the blood of the two six-nippled ewes, No. 76 and No. 256. He was, therefore, although black, used very extensively with the flock until white six-nippled rams appeared among his offspring, when they were substituted as the sires of the flock.

No. 810 and No. 827 (born 1898) were the first six-nippled rams employed in the flock; and six-nippled rams have been used ever since. In 1899, 25.6 per cent. of the lambs born were six-nippled, but in 1900 the percentage, for some unaccountable reason, fell to 4.4 per cent.; and the percentages in succeeding years, 1901, 1902 and 1903, were only 9.4 per cent., 9.6 per cent. and 11.1 per cent., showing a very slow rate of increase in spite of the fact that six-nippled rams had been used exclusively in the flock since the autumn of 1898.

There had been no difficulty in producing the four-nippled variety of sheep, because we had been able to obtain from surrounding farmers sheep with four nipples already fully developed to add to the flock, but in the case of the six-nippled variety we were unable to obtain this aid from the farmers.

No six-nippled sheep were to be had for love or money. We advertised for them and offered large prices. We notified butchers to examine the nipples of the sheep that came to them for slaughter, etc., but all in vain. During a period of thirteen years from the purchase of ewe No. 256, the only six-nippled sheep we were able to buy was a black ewe, No. 735, with very poorly developed extra nipples, which had been found by a butcher in Baddeck among the sheep purchased from farms in close proximity to Beinn Bhreagh, and which probably represented a leakage from our flock.

It will thus be seen that, as we were unable to obtain six-nippled blood from outside, the only way we could advance the formation of a six-nippled variety of sheep seemed to be: (1) To use six-nippled rams on the whole flock; (2) to select from the six-nippled ewes

born on the place those that had the most fully developed extra nipples, discarding the others.

The second plan seemed to be impracticable on account of the small number of six-nippled ewes that made their appearance. We had perforce to keep all the six-nippled ewe lambs that appeared in order to preserve the six-nippled strain from the danger of extinction. No selection by six-nippled ewes was possible; and the bulk of the flock remained four-nippled for years in spite of the continual use of six-nippled rams.

Females More Important than Males.—We recognized the fact that we were breeding for a female peculiarity; and that in this case selection by females was probably more important than selection by males.

In the hope of increasing the number of lambs from which selection could be made we determined to enlarge our flock; and, in the autumn of 1903, we purchased several four-nippled sheep and a large number of ordinary two-nippled ewes, and used our six-nippled rams with the whole flock. This plan increased the number of lambs born in 1904 and reduced the percentage of six-nippled sheep to 4.8 per cent.

After one winter's experience it became obvious that it was inadvisable to have a large flock on account of the increased expense and the difficulty of preserving accurate records with large numbers.

In the autumn of 1904, therefore, we cut down the flock to one half; retaining only ewes having four or more functional nipples, and in the spring of 1905 the percentage of six-nippled lambs rose to 25.8 per cent.; followed by 23.6 per cent. in 1906, and 27.7 per cent. in 1907.

It was speedily realized that with a small flock continuous inbreeding was inevitable; and that it would be very advisable to introduce new blood, as the flock was undoubtedly deteriorating physically. The difficulty, however, was that no six-nippled sheep could be found outside our own flock. We searched the country far and wide, and offered fancy prices without any success.

Avoiding the Evils of Inbreeding.—In the autumn of 1906 we tried the experiment of loaning a six-nippled ram to a neighboring farmer; and we offered him \$10.00 apiece for any six-nippled lambs produced, \$15.00 for seven-nippled and \$20.00 for eight-nippled lambs. As the result of this experiment we were able, in 1907, to purchase two six-nippled lambs.

The experiment of loaning a ram was tried again in the autumn of 1907, with the result that in 1908 we were able to purchase four six-nippled lambs, for which we paid the farmer \$40.00. This excited the interest of other farmers, who now began to apply for the loan of our rams under similar conditions of payment for lambs.

This plan of loaning rams turned out to be a success; and by the autumn of 1909 it became obvious that, by pursuing this plan, we could rely upon surrounding farmers for a continual supply of new six-nippled blood without keeping a large flock ourselves.

Giving up the Four-nippled Breed.—In the autumn of 1909, therefore, we cut down our flock to six-nippled ewes alone, and distributed our four-nippled and five-nippled ewes, as a *bonus*, among the farmers who would use our rams.

In the spring of 1910, 50 per cent. of the lambs born on Beinn Bhreagh were six-nippled; and we were also able to purchase a number of six-nippled lambs from the farmers. Very similar results were obtained in 1911.

This spring (1912) 53.6 per cent. of our lambs were six-nippled; and the records handed in by the farmers who have used our rams indicate that we shall probably be able to purchase from fifteen to twenty six-nippled lambs this year.

The New Departure.—As it has now been demonstrated that we can rely upon a constant influx of new six-nippled blood from outside, the time has come when we may begin the selection of six-nippled sheep by females. We propose to cut down our small flock still more this year, and keep only six-

nippled ewes that have all six nipples in a functional condition. We fully expect an increase in the percentage of six-nippled lambs born on Beinn Bhreagh next year, in spite of the fact of the large amount of alien blood in the flock. The new blood introduced has not diminished the proportion of six-nippled lambs born on the place, while it has resulted in increased vigor and strength in the flock as a whole. The physique has been improved to such an extent that there are now no better nor finer sheep than those to be found on Beinn Bhreagh.

A Discovery Relating to Color.—During the course of our breeding experiments a very curious fact made its appearance. It is well known that when white ewes are mated with white rams, black lambs occasionally appear among the offspring; but it has not hitherto been known that when black ewes are mated with black rams, the offspring are always black.

This fact was discovered by Dr. Davenport, Director of the Carnegie Institution's Station for Experimental Evolution at Long Island, N. Y., from a study of the records of the Beinn Bhreagh flock; and his conclusions have since been amply verified at Beinn Bhreagh and elsewhere.

Production of Twins.—The experience of the past has shown that twin lambs are usually the produce of old ewes; and the fact that 36 per cent. of the lambs born on Beinn Bhreagh are twins is very encouraging when we consider that they are the produce of young ewes.

We are getting twins from mothers that were only one year old, and two years old, at the time of the birth of their lambs; and 60 per cent. of the lambs born this spring from three-year-old ewes were twins.

We have only one old sheep on the place, No. 1505. She was seven years old this spring and has given us eleven lambs to date. She started out with twins when she was only a lamb herself (one year old) and has given us three sets of twins since then, besides three single lambs.

The indications are that our six-nippled

stock will ultimately turn out to be twin bearers, as a rule, when they become fully mature.

In the meantime the question is: What can we do to favor the production of twins in our flock?

1. One point of importance will be to see that twin ewes are mated with twin rams.

2. Twin-bearing ewes are, on the average, much heavier than single-bearing ewes. We would therefore favor the production of twins by weeding out from the flock, while still young, ewes that are markedly under the average weight of the ewes of their age.

3. When our flock of adult ewes is large enough to permit of selection it might be well to discard ewes at the age of three years, at all events at four, if they have never given us twins; so that the bulk of our fully mature females should ultimately be composed of ewes that have produced twins when young.

These points relate to efforts to increase the hereditary tendency to the production of twins; but there are other points relating to environment which are also of importance.

Condition of Nutrition Important.—The records of weight that have been preserved at Beinn Bhreagh seem to indicate that the condition of nutrition of the mother at the time of mating has an important influence upon the conception of twins. Our records show that the twin-bearing ewes increase in weight as the mating period approaches; and that mating occurs when the ewes are in prime physical condition.

This probably explains the curious fact that the ewes, which are mated in October, have a much larger proportion of twin lambs than those which are mated later on in the breeding season; thus verifying the old saying of the farmers here that "March lambs bring twins." The pasture is at its best in October. It begins to fail in November, and by December there is very little left. Our records show that when ewes are mated in October the proportion of twins born is larger than when mating occurs in November, and that very few of the ewes mated in December have twins.

In order to favor the production of twins it is therefore necessary, or at least advisable,

that the ewes should be in prime physical condition at the time of mating.

To secure this point we breed in October; and it has also been our custom for some years past to provide the ewes with extra nourishment in the form of oats, oil-cake, etc., for two or three weeks before mating.

In order to be perfectly sure that each ewe receives her proper share, individual feeding pens have been provided.

When a common trough is used the larger and stronger sheep, who need it least, get most of the food; and the smaller and weaker, who need it most, get least.

Nutrition After Mating.—Our records of weight indicate that there is a characteristic difference in the weights of twin-bearing and single-bearing ewes after mating.

The twin-bearing ewes, on the average, show a marked and even sudden dropping off in weight within two or three weeks after mating, which is not found in the case of the average single-bearing ewe.

This may be translated to mean *lowered nutrition after mating as a characteristic of the twin-bearing ewe*; and a consequent lessening of the growth of the unborn lambs, so that when the twin lambs are ultimately born they are of smaller size and weight than the average single lamb.

We sometimes find that twin lambs are very unequal in size at birth. If one is large the other is likely to be small and even deformed, indicating a struggle for existence between the unborn lambs.

This led me to suspect that many of our largest single lambs might be the survivors of twins; and a few years ago I had a young physician from Washington (Dr. Phelps) visit Beinn Bhreagh at the lambing season to see what he could discover bearing upon the point.

He was able to examine quite a number of the after-births of the sheep; and in several cases where single lambs had been produced he found indications in the after-birth of an aborted twin.

In this connection it is suggestive that our best twin-bearing ewe, No. 1505, which has

given us already four sets of twins, produced this year a single lamb *weighing ten pounds at birth!* It is notorious also, that fat stock are remarkably infertile, and rarely bear twins.

All these considerations led to the belief that lessened nutrition during the period of gestation is a condition that is favorable to the preservation of unborn twins. Good nutrition at the time of mating favors the *conception* of twins; and diminished nutrition after mating favors their retention.

It is obvious, upon reflection, that ewes can not successfully bear twins, or a litter at birth, unless the lambs born are small; and lessened nutrition during the period of gestation is eminently favorable to the production of lambs that are small at birth.

These considerations led to the policy of giving the ewes extra nourishment in the form of oats, oil-cake, etc., for some time before mating; and then cutting off the extra feed soon after mating so as to throw the ewes back on the pasture alone for support.

A better, and certainly more economical plan, affecting the condition of nutrition in the same way, would be simply to mate in October when the pasture is at its best, and then give hay alone for winter feeding. The giving of oats, oil-cake, roots and other milk-promoting food might well be postponed until about the time of lambing, so as to avoid stimulating the growth of the lambs until after they are born.

In order to raise twins and triplets successfully the lambs should be small at birth, and grow large afterwards.

If we had a large number of twins from which to choose, it would be a good plan in the spring to retain only those lambs which are under the average weight at birth; and then, in the autumn, select from these those that are over the average weight. This process carried on through a series of generations would probably result in a breed of sheep producing, as a normal condition, lambs that are small at birth and which grow large afterward.

ALEXANDER GRAHAM BELL